An Interactive Budget Model for Production, Harvesting, Handling and Delivering Switchgrass to an Energy Plant

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Introduction

Agronomic, small plot research has shown that switchgrass (*Panicum virgatum*), which is native to North America, is capable of producing high biomass yields with relatively low fertilizer inputs.[1] This, along with other features like its perenniality, adaptation to a wide range of soils, and tolerance of drought, has made it a promising energy crop. It also dries relatively quickly in warm weather after mowing, which makes it particularly suitable for combustion technologies. However, very little research has been conducted on both the physical and economic aspects of producing, harvesting, handling and transporting switchgrass on a commercial scale. Without this information, the risk associated with commercializing switchgrass as an energy crop will be high. Therefore, the objective of this study was to develop an interactive economic model that can provide flexibility in determining the costs of producing, harvesting, handling and transporting switchgrass to an energy plant.

For many years, agricultural economists and agricultural engineers have cooperated to produce farm level crop budgets delineating cultural practices, consequent production costs and expected returns for major crops. Following the general form and established methods for estimating crop budgets, researchers have developed an interactive spreadsheet model that can be used to better understand the fundamental elements of alternative switchgrass production and handling systems, and to identify system elements that require more research. This work was undertaken for the Southern Research Institute and the United States Department of Energy, under DOE Cooperative Agreement No. DE-FC36-98GO10349.

Model Configuration

The model consists of eleven Excel worksheets:

1. Summary Page: contains variables and assumptions used throughout the model and summarizes the results obtained from selected combinations of the other worksheets.
2. Establishment 1: projects establishing the crop on sod.
3. Establishment 2: projects establishing the crop on previously cropped land.
4. Maintenance: projects annual stand maintenance practices.
5. Harvest 1: projects annual harvesting into large round bales.
6. Harvest 2: projects annual harvesting with a field chopper.
7. Transportation 1: projects transporting bales and grinding them at the point of use.
8. Transportation 2: projects transporting loose chop in a walking floor trailer.
9. Transportation 3: projects compacting loose chop with a cotton module builder, transporting the material with a module hauler, and feeding the modules into the generating facility with a module feeder.
10. Transportation 4: projects pelletizing loose chop and transporting bulk pellets in a walking floor trailer.
11. Machinery Calculator: provides machinery cost estimates for the equipment designated on other worksheets. Also contains selected machinery, not designated in the original formulations, that a user might wish to employ in an alternate evaluation.

The Summary Page contains variables used throughout the model, so that alternative values or specifications need be entered in only one place. These variables include the unit size (1 acre is traditional enterprise unit in budgeting), personal property tax rate, insurance rate, a general overhead charge rate, farm labor wage rate, annual crop yield, stand life of the crop, annual cropland rental value, mileage from farm to energy plant, farm fuel or energy prices (no hwy. taxes), and the hauling capacities of highway trucks under each transportation option. Other variables which are not specified in common throughout the model, such as machinery, pesticides and fertilizers, are delineated on the individual worksheets, and are also designed to be easily changed by a user.

Summary

The model facilitates derivation of cost estimates as one or two factors are varied throughout their reasonable ranges. This facilitates creation of graphs that, for example, project changes in total costs per ton of delivered switchgrass with variations in yield and method of transportation, truck capacities and method of transportation, or stand life and yield. Results such as these have provided a better understanding of the interaction among the various cost factors for producing, processing and delivering switchgrass to energy facilities. They have also helped to identify some of the potentially more important areas for further research.

Present model estimates indicate that, at current prices, bio-fuels are about twice as expensive as coal per million BTUs. These estimates give credence to proposals for federal programs to partially offset costs for using biomass fuels. Environmental programs offering carbon credits or credits for rural development could make switchgrass cost competitive.

References

1. Sladden, S. E., D. I. Bransby and G. E. Aiken, Biomass yield, composition and production costs for eight switchgerass varieties in Alabama. *Biomass and Bioenergy*, Vol. 1, No. 2, pp 119-122, Pergamon Press plc, (1991).